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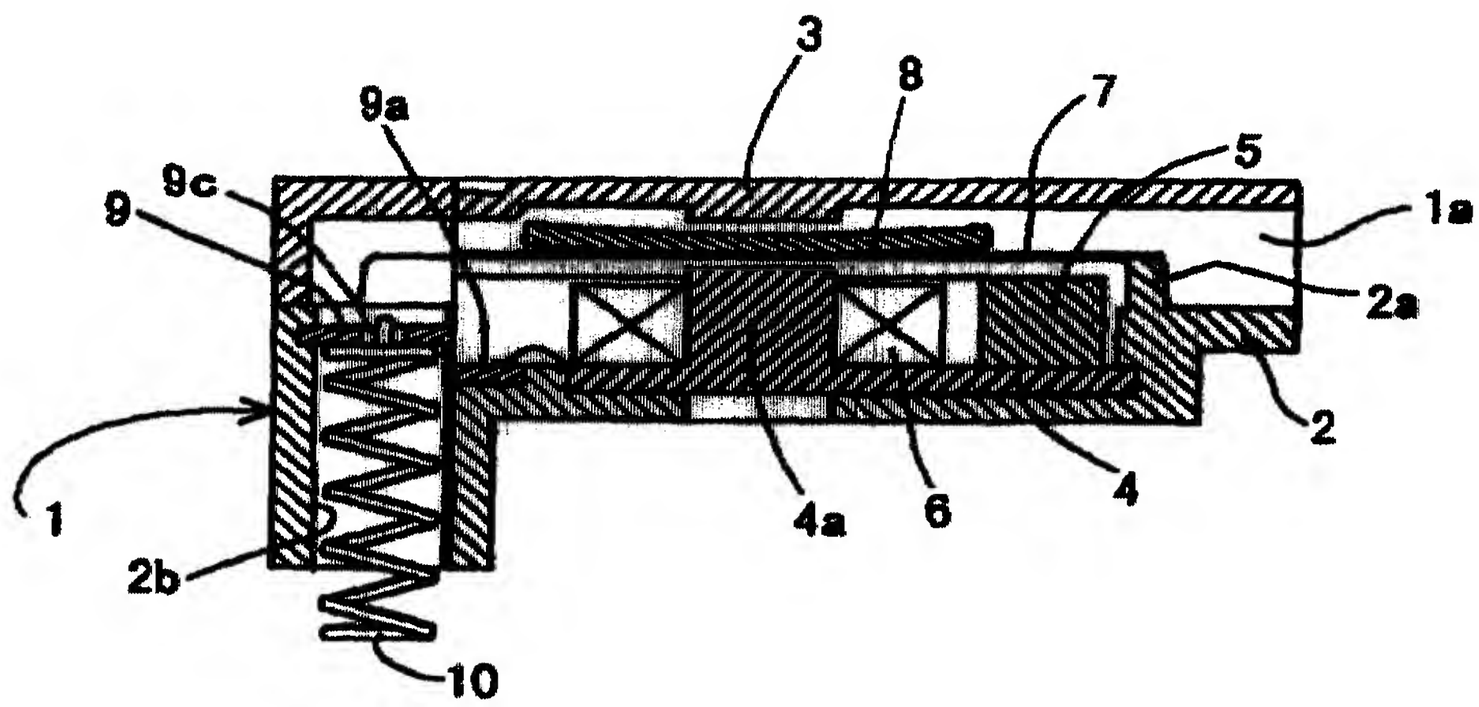
(54) Electromagnetic sound generator

(57) An electromagnetic sound generator has a vibrating plate mounted in a case. An armature is secured on the vibrating plate at a central portion thereof. The armature has a concave spherical shape.

FIG. 1



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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to an electromagnetic sound generator, and more particularly to a vibrating plate of the sound generator.

[0002] In recent years, there is developed the surface mount technology where electronic parts are directly mounted on a printed circuitboard. The electromagnetic sound generator used in the portable telephone and beeper is also mounted on the circuit board.

[0003] Fig. 5 is a plan view of a conventional electromagnetic sound generator in which upper parts thereof are removed along a line V-V of Fig. 6. Fig. 6 is a sectional view taken along a line VI-VI of Fig. 5, and Figs. 7a and 7b are sectional views of a vibrating plate of the sound generator.

[0004] Referring to Figs. 4 and 5, a case 50 of the electromagnetic sound generator comprises a lower case 51 and an upper case 52. A pair of cylindrical holes 51b are formed in the lower case 51, and an annular projection 51a is formed on the lower case 51.

[0005] A yoke 53 made of magnetic material is mounted on the bottom of the lower case 51. A core 53a is formed on the surface of the yoke 53 and a notch 53b is formed in the yoke 53. An annular magnet 55 and a coil 54 are mounted on the yoke 53. A circular vibrating plate 56 is secured on the annular projection 51a. An armature 57 comprising a circular magnetic plate is secured to the vibrating plate 56 at the central portion thereof so as to oppose to the core 53a. Thus, a magnetic circuit for a buzzer is formed by the yoke 53, core 53a, magnet 55 and vibrating plate 56.

[0006] A pair of lead plates 58, each of which is made of an elongated metal plate, are embedded in the lower case 51. Each of the lead plates 58 is extended between the upper end of the hole 51b and an end 58a in the notch 53b of the yoke 53. A coil spring 59 is inserted in each hole 51b. An upper end of the coil spring 59 is inserted in a hole 58c formed in an end portion 58b of the lead plate 58 and electrically connected to the lead plate 58 by solder. The lower end of the spring 59 is projected from the lower case 51. The upper case 52 is adhered to the lower case 51 so that a sound emanating hole 50a is formed between the upper case 52 and the lower case 51.

[0007] When a signal current flows in the coil 54 passing through springs 59 and lead plates 58, the coil 54 is excited to attract the armature 57. Thus, the armature 57 is vibrated to produce sounds which emanate from the sound emanating hole 50a.

[0008] As shown in Fig. 7a, the armature 57 is a flat magnetic plate formed by stamping out a flat material plate. When the armature 57 is attracted to the core 53a, the vibrating plate 56 is bent as shown in Fig. 7b. As a result, there occurs stress concentration along the peripheral edge of the armature 57. The concentrated stress restrains the vibrating plate 56 from vibrating, which causes the vibration to be unstable.

SUMMARY OF THE INVENTION

[0009] An object of the present invention is to provide an electromagnetic sound generator in which a vibrating plate may be stably vibrated without stress concentration, thereby providing a stable sound emanating characteristic.

[0010] According to the present invention, there is provided an electromagnetic sound generator comprising a case, an electromagnet having a vibrating plate mounted in the case, an armature secured on the vibrating plate, wherein the armature having a concave spherical shape, and secured to the vibrating plate at a central portion thereof.

[0011] The armature has a uniform thickness.

[0012] The armature has a radius curvature so that a peripheral edge of the armature does not contact with the vibrating plate when the vibrating plate is vibrated at a maximum amplitude.

[0013] These and other objects and features of the present invention will become more apparent from the following detailed description with reference to the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

[0014]

Fig. 1 is a sectional view of an electromagnetic sound generator according to the present invention;
Fig. 2 is a plan view of the sound generator;
Figs. 3a, 3b and 3c show steps for press working for manufacturing an armature of the present invention;
Figs. 4a and 4b show sectional views showing vibrating states of a vibrating plate of the present invention;
Fig. 5 is a plan view of a conventional electromagnetic sound generator in which upper parts thereof are removed along a line V-V of Fig. 6;
Fig. 6 is a sectional view taken along a line VI-VI of Fig. 5; and
Figs. 7a and 7b are sectional views of a vibrating plate of the sound generator.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0015] Referring to Figs. 1 and 2, a case 1 of the electromagnetic sound generator of the present invention has a case comprising lower case 2 and an upper case 3. A pair of cylindrical holes 2b are formed in the lower case 2, and an annular projection 2a is formed on the lower case 2.

[0016] A yoke 4 made of magnetic material is mount-

ed on the bottom of the lower case 2. A core 4a is formed on the surface of the yoke 4 and a notch 4b is formed in the yoke 4. A circular magnet 5 and a coil 6 are mounted on the yoke 4. A circular vibrating plate 7 is secured on the annular projection 2a. An armature 8 comprising a circular magnetic plate is secured to the vibrating plate 7 at the central portion thereof so as to oppose to the core 4a. Thus, an electromagnet having a magnetic circuit comprising the yoke 4, core 4a, magnet 5, armature 8 and vibrating plate 7 is formed.

[0017] A pair of lead plates 9, each of which is made of an elongated metal plate, are embedded in the lower case 2. Each of the lead plates 9 is extended between the upper end of the hole 2b and an end 9a in the notch 4b of the yoke 4. A coil spring 10 is inserted in each hole 2b. An upper end of the coil spring 10 is inserted in a hole 9c formed in an end portion 9b of the lead plate 9 and electrically connected to the lead plate 9 by solder. The lower end of the spring 10 is projected from the lower case 2. The upper case 3 is adhered to the lower case 2 so that a sound emanating hole 1a is formed between the upper case 3 and the lower case 2.

[0018] The armature 8 is formed into a concave spherical shape in accordance with the present invention. The armature 8 is fixed to the vibrating plate 7 at a central portion by pinpoint welding.

[0019] Referring to Figs . 3a and 3b, the press machine comprises a die 20, a pair of pilot punches 21, a striking punch 22 having a spherical working surface 22a, and a blank-through punch 23. These punches 21, 22 and 23 are arranged in the moving direction of a strip 30. The die 20 has a pair of pilot positioning holes 21a, a concave spherical recess 22b, and a blanking hole 23a.

[0020] The strip 30 is intermittently fed to the right in Fig. 3a, and positioned by engaging the pilot punches 21 with pilot holes 30a formed in the strip 30. Assuming that the strip 30 is fed to the position shown in Fig. 3a, the striking punch 22 and the blank-through punch 23 strike the strip 30. The striking punch 22 bends the strip 30 into a concave spherical shape by the spherical working surface 22a and the concave spherical recess 22b to form a concave portion 30b. The blank-through punch 23 blanks the strip 30 along a periphery of the concave portion 30b formed by the striking punch 22 with the blanking hole 23a. Thus, a concave plate 30c as the armature 8 is produced having a uniform thickness. The concave plate 30c is push-backed to the strip 30 and fed to a next step together with the strip 30, where the vibrating plate 7 is fixed by a spot welding (pinpoint welding).

[0021] Fig. 4a shows a sectional view of the armature 8. Since the armature 8 is bent into a spherical shape at a radius of curvature, a gap G is formed between the peripheral edge of the armature and the vibrating plate 7.

[0022] When the coil 6 is energized, the armature 8 is attracted to the core 4a. As shown in Fig. 4b, even if the armature vibrates at a maximum amplitude, there remains a gap G. The radius of curvature is therefore selected so that the peripheral edge of the armature does contact with the vibrating plate 7 when the armature 8 vibrates at a maximum amplitude. Thus, stress concentration does not generate along the peripheral edge of the armature 8. Therefore, the vibration of the vibrating plate 7 is not restrained.

[0023] In accordance with the present invention, since the vibration of the vibrating plate is not restrained by the stress concentration, the vibrating plate stably vibrates.

[0024] While the invention has been described in conjunction. with preferred specific embodiment thereof, it will be understood that this description is intended to illustrate and not limit the scope of the invention, which is defined by the following claims.

Claims

1. An electromagnetic sound generator comprising:

   a case;
   an electromagnet having a vibrating plate mounted in the case;
   an armature secured on the vibrating plate, wherein the armature having a concave spherical shape, and secured to the vibrating plate at a central portion thereof.

2. The electromagnetic sound generator according to claim 1 wherein the armature has a uniform thickness.

3. The electromagnetic sound generator according to claim 1 wherein the armature has a radius curvature so that a peripheral edge of the armature does not contact with the vibrating plate when the vibrating plate is vibrated at a maximum amplitude.

FIG. 1

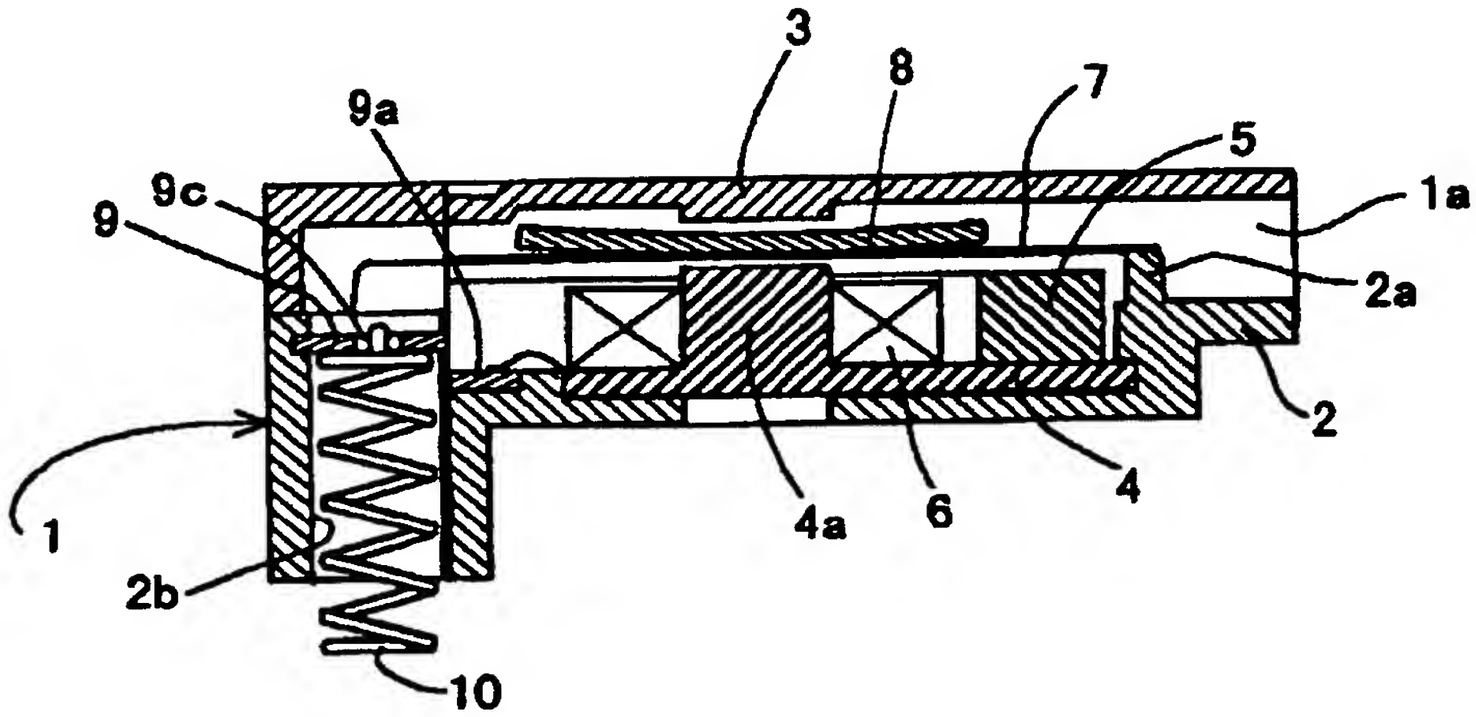
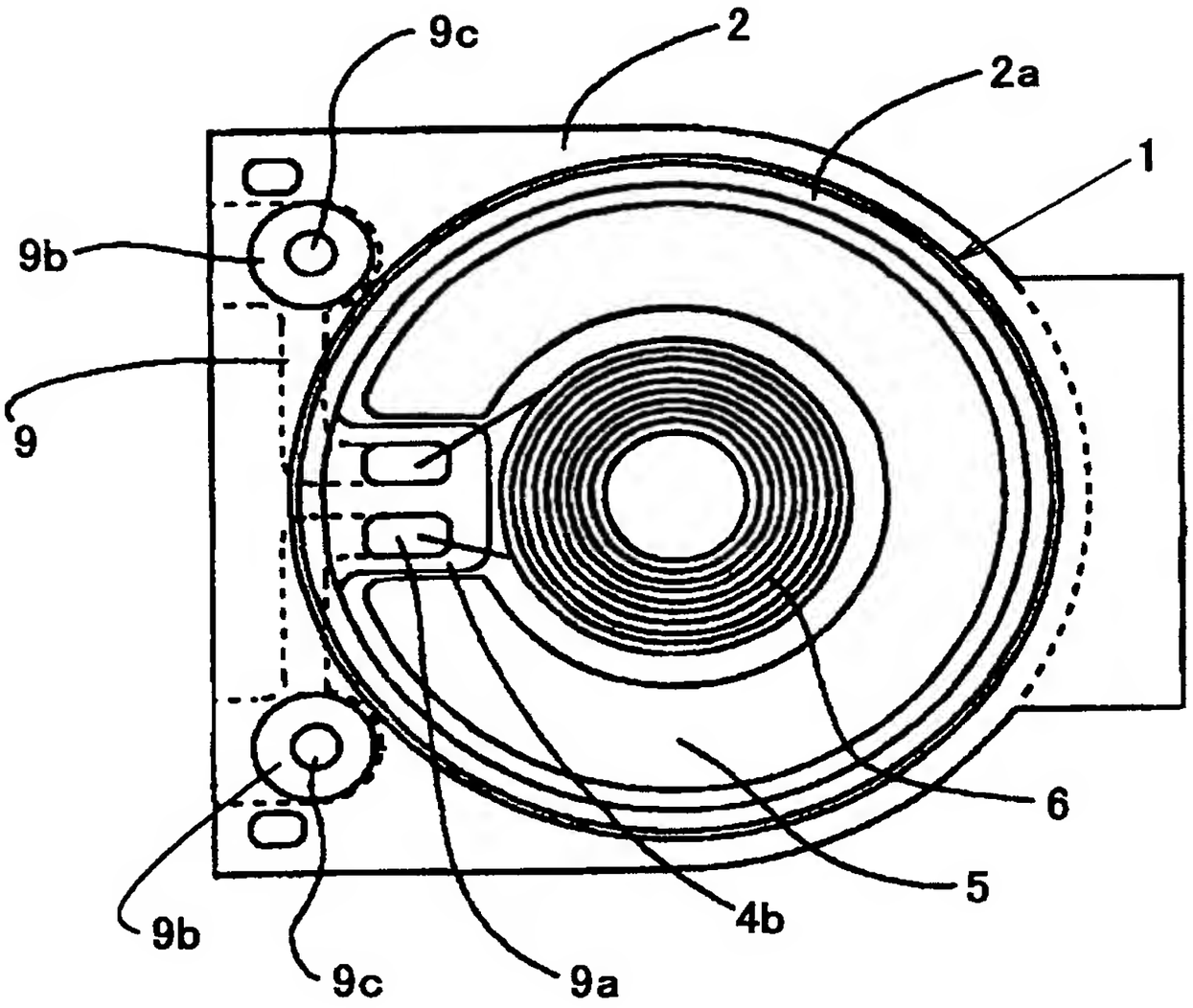


FIG. 2



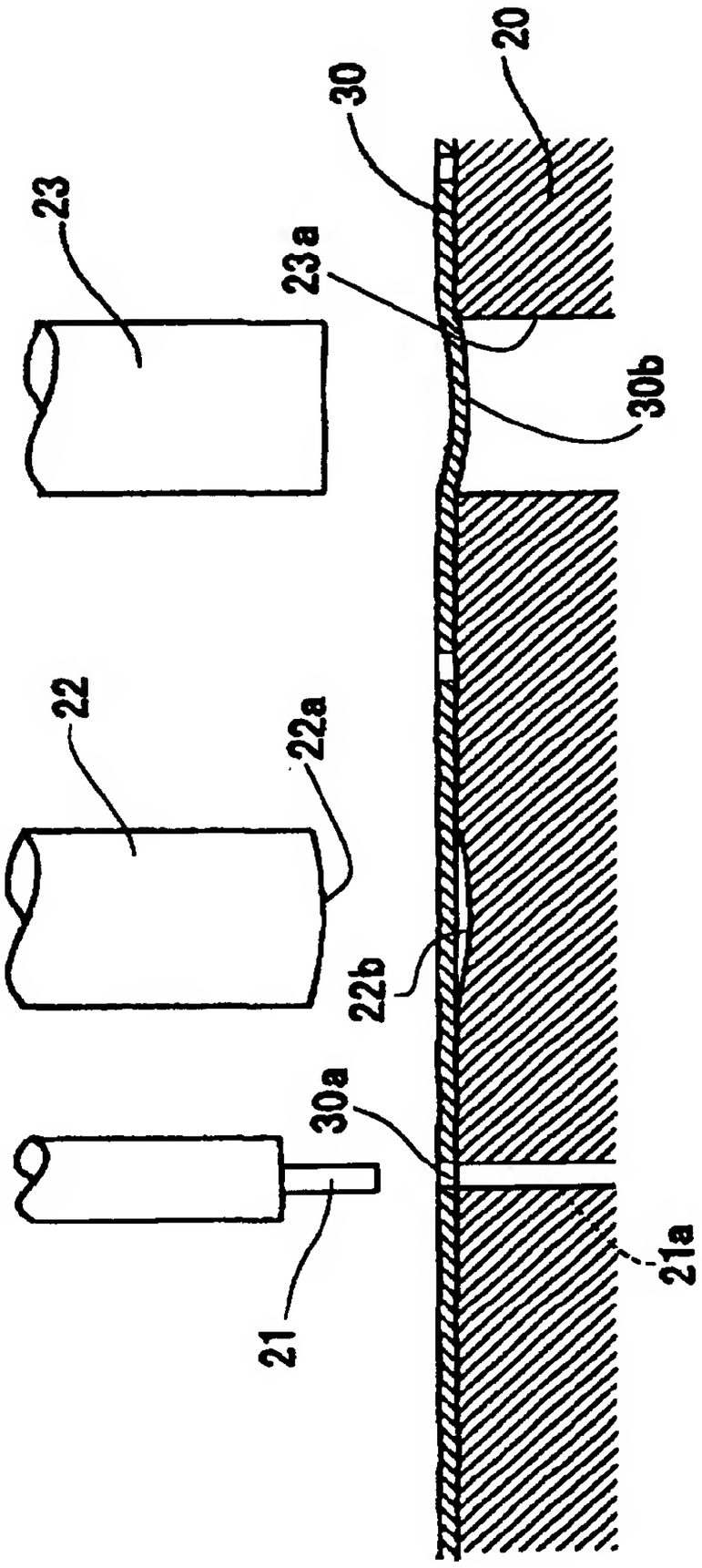


FIG. 3a

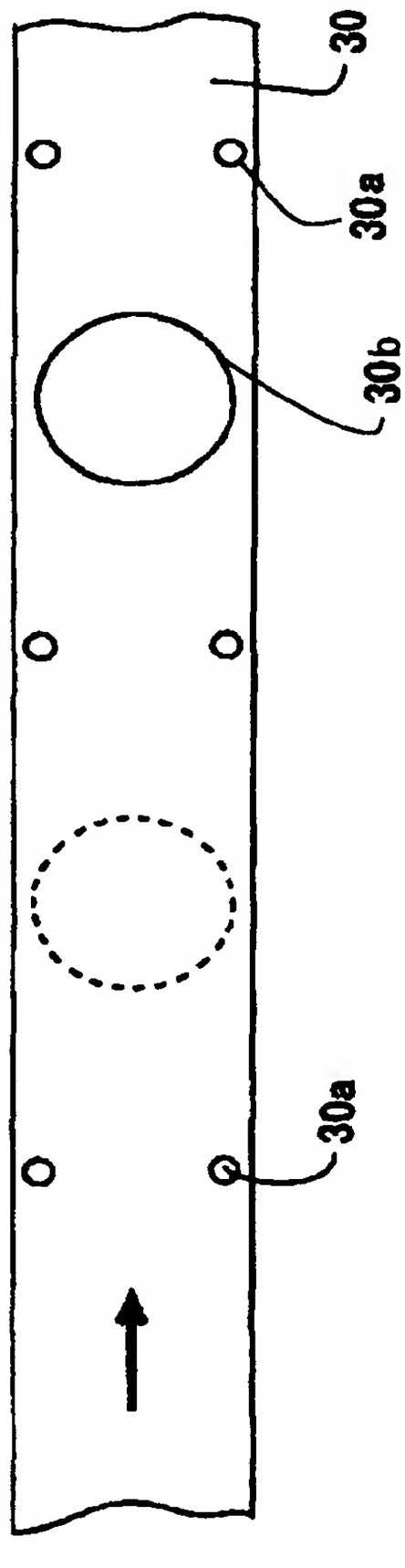


FIG. 3b

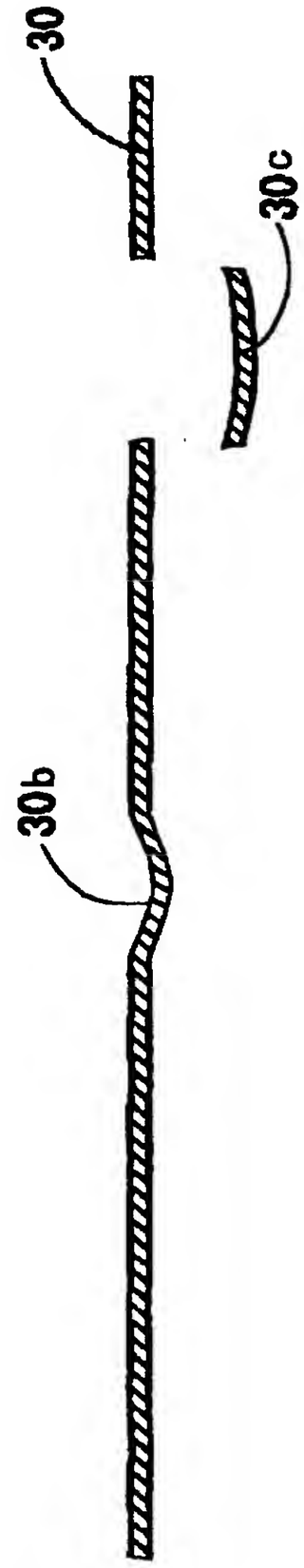


FIG. 3c

FIG. 4a

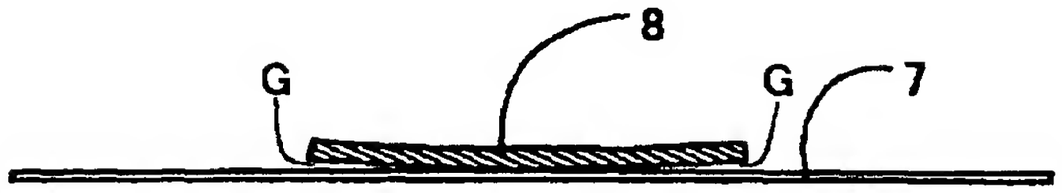


FIG. 4b

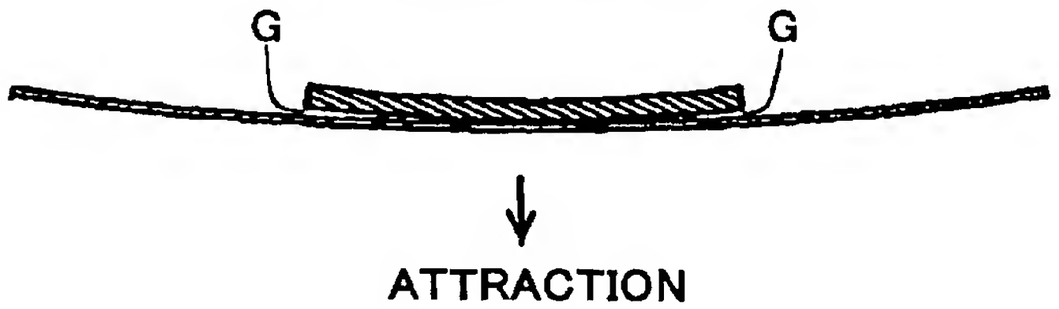


FIG. 5

PRIOR ART

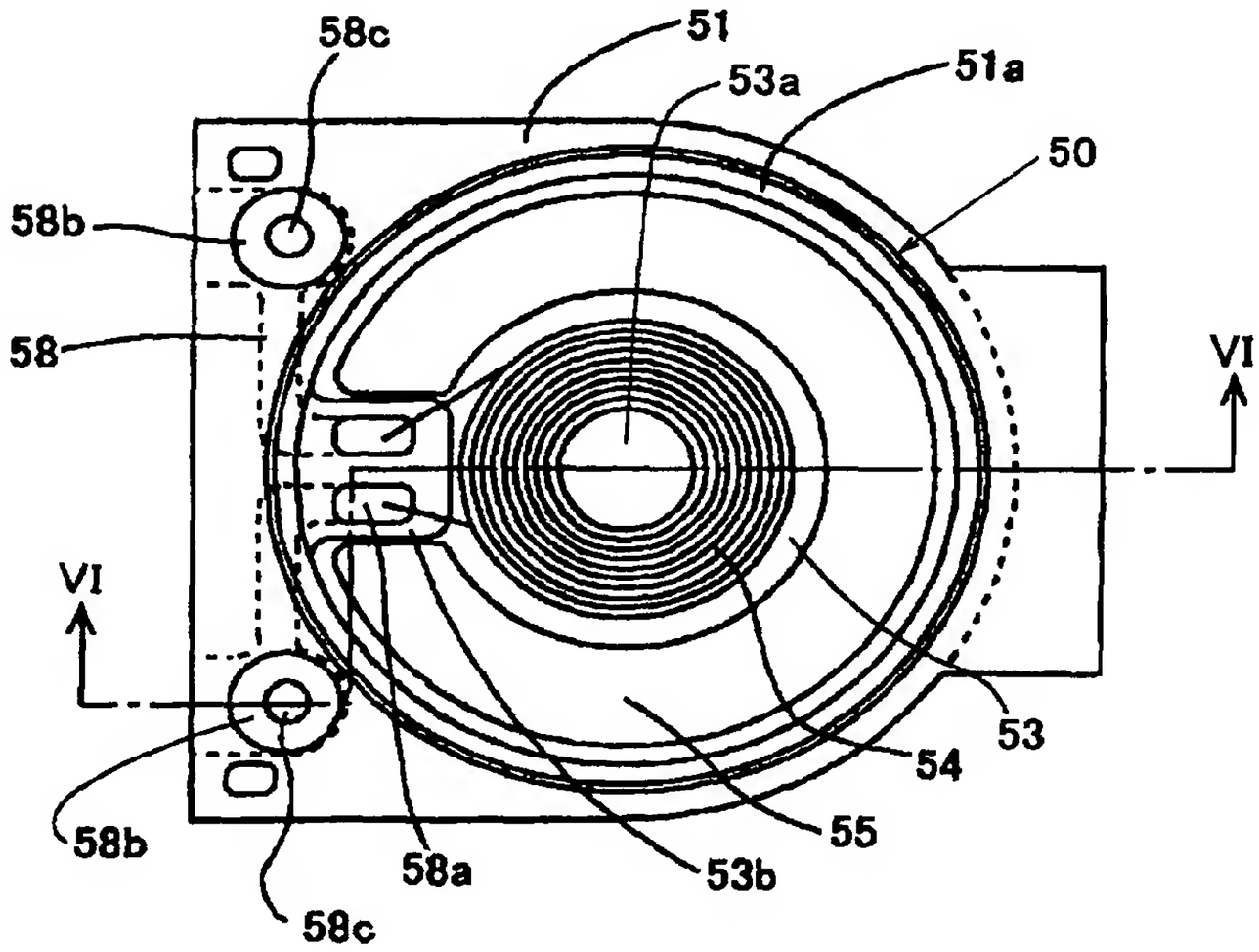


FIG. 6

PRIOR ART

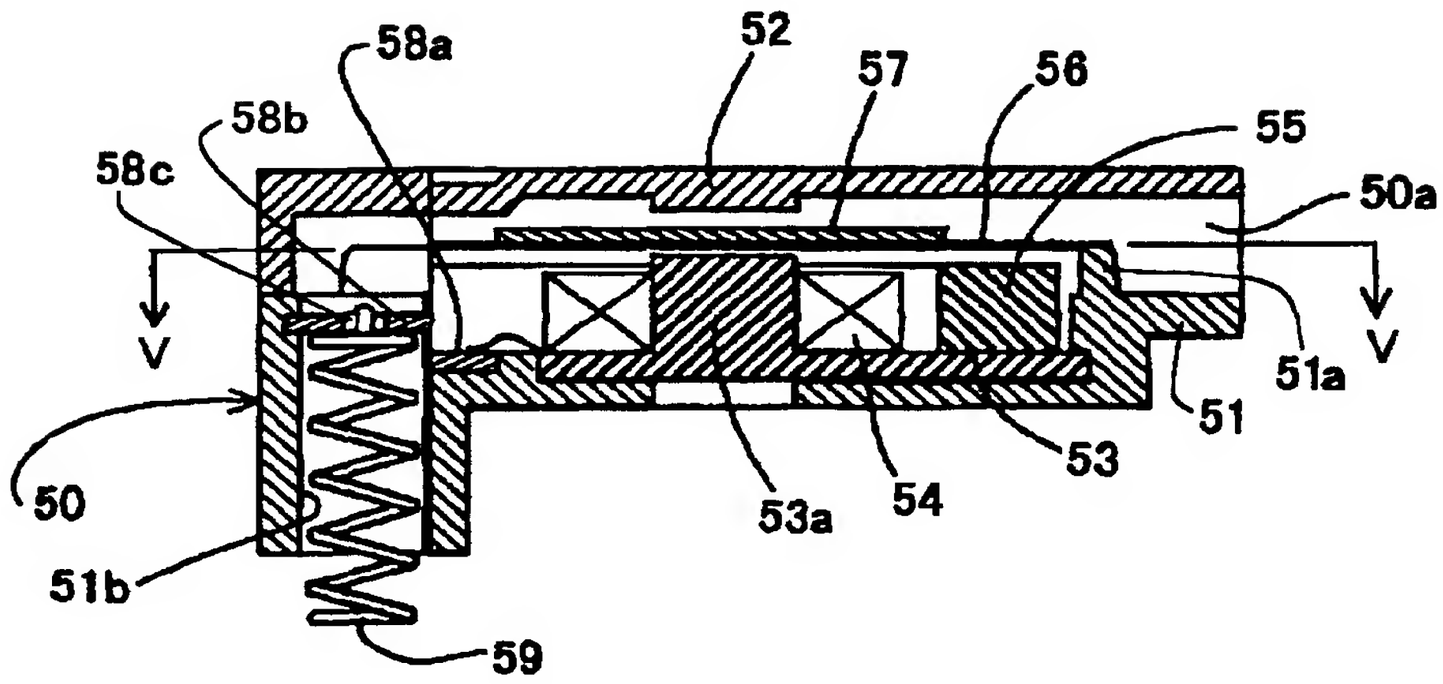


FIG. 7a

PRIOR ART

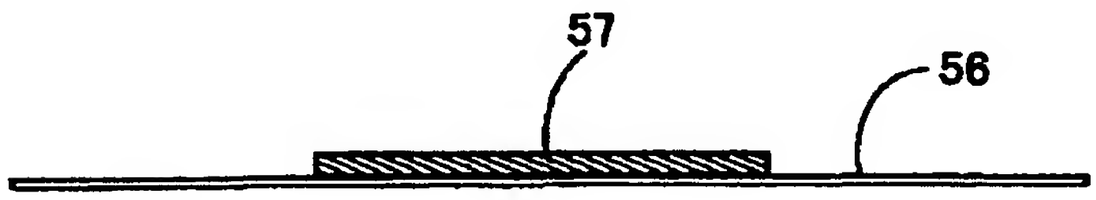
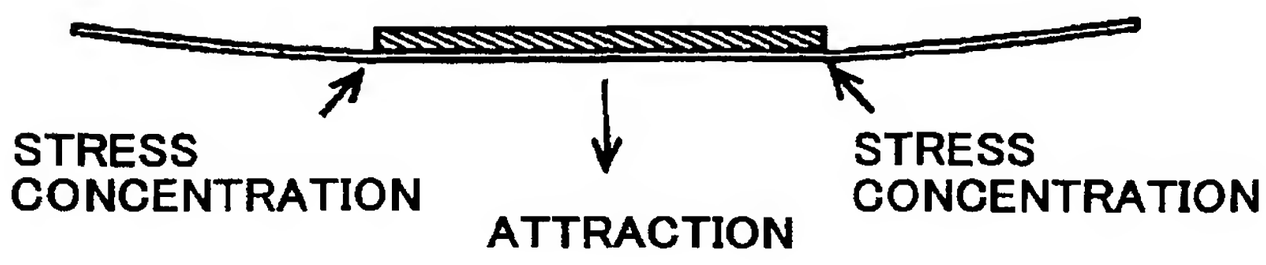


FIG. 7b

PRIOR ART



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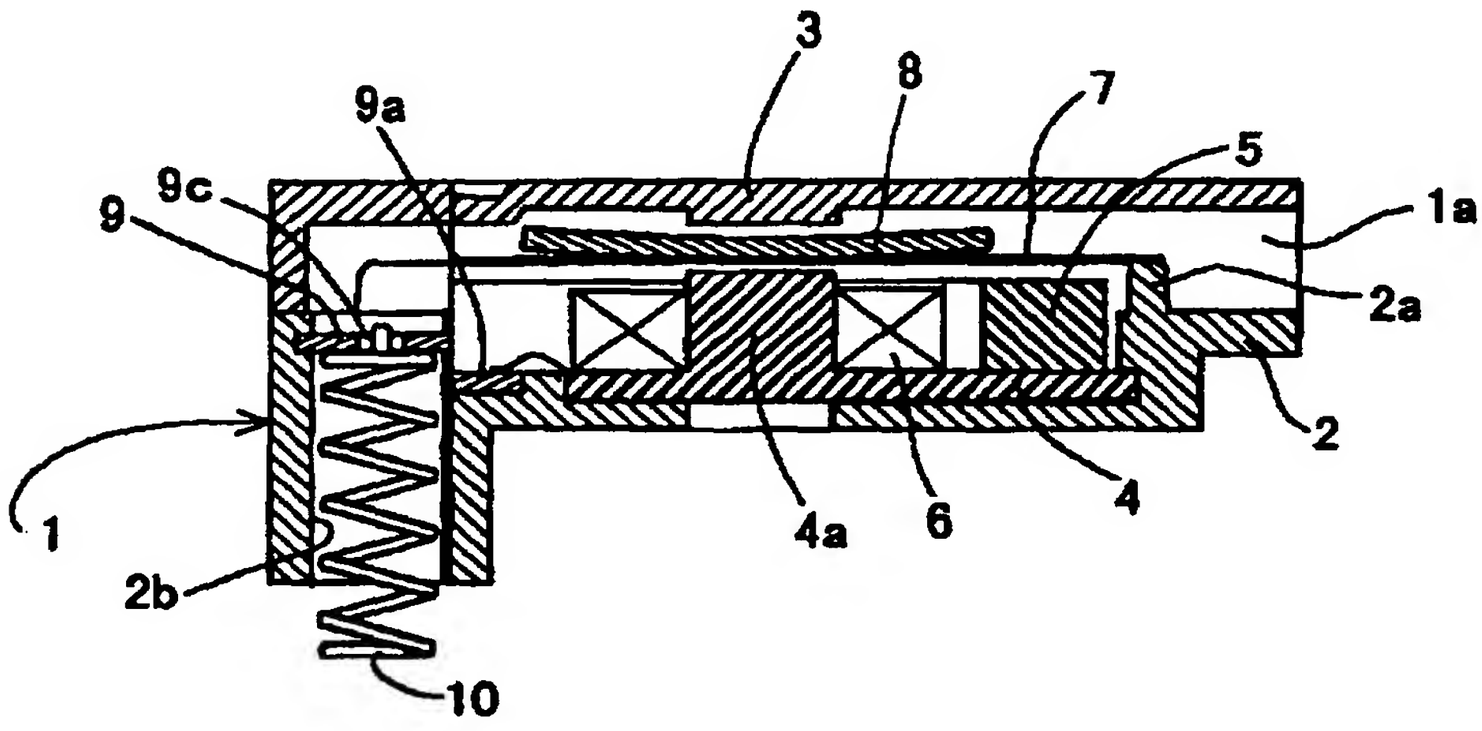

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EUROPEAN SEARCH REPORT

Application Number
EP 01 10 8532

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 6 023 518 A (KUWABARA ET AL) 8 February 2000 (2000-02-08) * the whole document * -----	1	INV. H04R11/02
A	PATENT ABSTRACTS OF JAPAN vol. 1998, no. 12, 31 October 1998 (1998-10-31) & JP 10 187160 A (CITIZEN ELECTRON CO LTD), 14 July 1998 (1998-07-14) * abstract * & US 6 108 432 A (WATANABE ET AL) 22 August 2000 (2000-08-22) * column 4, line 15 - line 67; figure 1 * -----	1	

TECHNICAL FIELDS SEARCHED (IPC)

H04R
G10K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	6 September 2006	Wanzeele, Raphaël

CATEGORY OF CITED DOCUMENTS

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